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Biopile remediation is an environmental cleanup technology that uses naturally occurring microbes such as bacteria and fungi to destroy organic contaminants in soil. Certain species of bacteria are able to consume organic pollutants as a food source, thus detoxifying the pollutants. Biopile remediation is effective in treating soils contaminated with petroleum hydrocarbons such as gasoline, grease, jet fuels, diesel fuels, and motor oil. The microbes' "appetite" is enchanced by blowing air through the contaminated soil pile to provide oxygen and adding fertilizer to provide additional soild nutrients.

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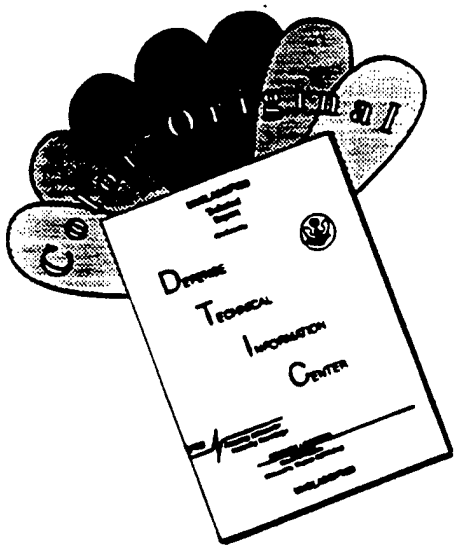

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TechData Sheet

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Port Hueneme, California 93043-4370

SERDP
Strategic Environmental Research and Development Program
Improving Mission Readiness Through Environmental Research

TDS-2018-ENV (Revised) **March 1997**

Advanced Fuel Hydrocarbon Remediation National Test Location

Biopile Remediation

Conducted by:

Naval Facilities Engineering Service Center, Port Hueneme, CA
and
ENSR Consulting and Engineering, Camarillo, CA

Biopile remediation is an environmental cleanup technology that uses naturally occurring microbes such as bacteria and fungi to destroy organic contaminants in soil. Certain species of bacteria are able to consume organic pollutants as a food source, thus detoxifying the pollutants.

Biopile remediation is effective in treating soils contaminated with petroleum hydrocarbons such as gasoline, grease, jet fuels, diesel fuels, and motor oil.

Contaminated soil is placed into engineered piles 8 to 12 feet high and approximately 100 feet long on a waterproof liner (see Figure 1). The microbes' "appetite" is enhanced by blowing air through the contaminated soil pile to provide oxygen and adding fertilizer to provide additional solid nutrients.

Figure 1. Preparing contaminated soil piles for biopile remediation.

Purpose of the Biopile Remediation Demonstration at Port Hueneme

Investigation of biopile remediation is currently being conducted at the Construction Battalion Center (CBC) in Port Hueneme. Optimization of soil pretreatment, design and placement of aeration pipes, water and nutrient delivery, leachate collection, and offgas treatment is being performed.

Advantages of Biopile Remediation

Biopile remediation, in general, has several advantages:

- Is a straightforward process and is easy to implement.
- Is a low-cost technology relative to other remedial alternatives (such as incineration).

- Non-volatile contaminants are destroyed, not transferred to another medium.

- Is permanent (in that contaminants may be completely degraded to carbon dioxide and water).

Biopile remediation has the following advantages over naturally aerated processes:

- Speeds up contaminant degradation rates (and thus reduced treatment times).

- Requires smaller land surface area (particularly in contrast with land farming).

- Controls process parameters such as air flow, moisture, nutrients, and temperature better.

- Controls off gases easier, if required.

- Costs less and is easier to collect and reycle the water runoff (leachate).

- Dirt clods that impede air diffusion are less likely to be formed than in tilling the soil.

Technical Description of Biopile Remediation Technology

Remediation uses microorganisms to degrade and/or detoxify contaminants. This degradation results in the breaking down of contaminants into simpler compounds that are less toxic. If the process leaves only carbon dioxide and water as end products, biodegradation is complete, and mineralization is said to have occurred.

Biopile bioremedation is an *ex situ* version of soil bioventing in which air is pulled or blown through soil to stimulate indigenous hydrocarbon-degrading microorganisms. Throughout the period of remediation, the soil is physically undisturbed while a proper environment is maintained to enhance and maintain acceptable rates of degradation. A schematic of a representative biopile remediation system is provided in Figure 2.

After the contaminated soil is excavated, it may be pretreated before being placed in the engineered piles. For example, if large rocks or debris are present, they may be removed by screening. In addition, additives such as fertilizer (to provide nitrogen and phosphorous), mulch or sand (to increase porosity), and lime (to raise pH) may be added during the pile construction.

The excavated soil (with rocks and debris removed) is then placed on a prepared bed. The bed is prepared by spreading a 12-inch layer of noncontaminated soil over a waterproof liner. Perforated pipes are then placed over the soil layer in regularly spaced intervals. A layer of gravel is usually placed over the pipes, and the excavated and prepared soil is then placed in 8- to 12-foot high piles.

The perforated pipe system aerates the soil piles by either blowing air through the pipes into the soil or drawing air from the ambient atmosphere around the pile through the soil. The preferred method is to draw air through the pile. In this way, offgases can be controlled and air flow can be easily monitored. Air drawn from the pile could contain volatile components and may require treatment before discharging it o the atmosphere if permitted levels are exceeded. Activated carbon adsorption is the most common means of treating the off gases.

Moisture content within the pile is maintained with an irrigation system (e.g., drip or soaker hoses). Liquid nutrients can be applied to the top of the pile and allowed to percolate through the pile. Alternatively, solid nutrients (fertilizer) can be mixed with the excavated soil prior to construction of the pile, added to the pile during construction, or scattered over the surface of the completed pile.

A water run off (leachate) collection system is installed. To the maximum extent possible, the leachate will be collected in drums or tanks and recycled to the pile via the irrigation system.

In summary, biopile remediation technology consists of site preparation, soil pretreatment, design and placement of aeration pipes, an air handling system, water and nutrient delivery, and additional features, such as leachate collection and offgas treatment.

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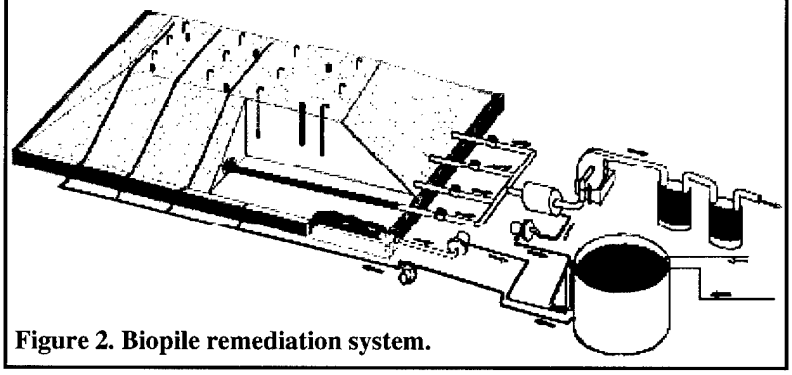

Figure 2. Biopile remediation system.

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